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BIOC 318 : LABORATORY STUDIES IN APPLIED MICROBIOLOGY Spring 2017

Welcome to BIOC 318, Laboratory Studies in Applied Microbiology

In fall 2016 we significantly revised the content of this course to focus on a single, albeit ambitious, project to characterize the resident flora (primarily bacteria) of a local water source. The changes were very well received and the benefits of the new course design far outweighed the bumps in the road that are inevitable when one makes major changes to an established course design.

This page is reproduced on the web at the following URL: http://www.ruf.rice.edu/~bioslabs/BIOC318/index.asp. Essential documents, including a course syllabus, guides to methodology, laboratory responsibilities, etc., are accessible from the side bar on the web page and can be found as pdfs in the Resources section on this site.

Example of some of the work you will conduct in this course. (A) Agar plates with bacterial unknowns, 72h following aerobic incubation at 30°C. *(B)* Identically streaked agar plates incubated anaerobically for 72h, revealing relationship to oxygen.

Our project

Many studies of samples taken from a wide variety of sources have revealed that between 0.01 and 0.1% of all bacterial cells that can be seen in a light microscope are "uncultivable" in the laboratory.[1] This means that for every bacterial species successfully isolated from an environmental sample, as many as 10,000 species remain undetected. Our project seeks to find and characterize some of this "dark matter" of the microbiome. Our overall goals are:

- to estimate how many bacterial species can be cultured from an environmental source using conventional methods
- to establish a starting point by identifying and characterizing the "cultivable" species from the source
- to isolate currently "uncultivable" species by (1) applying recently developed published methods and (2) developing and applying methods of our own

Scientists have estimated that up to one trillion microbial species exist on Earth, about 0.001% of which are actually known.[2] If the one trillion estimate is accurate, then if 100 Rice students *each* discover 100 new species every year (obviously not a realistic expectation), it will take 100 million years to discover all of them. Realistically, we'll be very happy if we discover even one new species or strain of bacteria. Achieving our third project goal, especially part 2, will be challenging, and success is not guaranteed. In fact, most scientific experiments result in failure. What we have to keep in mind is that each step that we take, whether or not it ends in failure, is a step that we will not have to repeat. Even a failed attempt represents progress.

Why pursue this project? What good will it do anyone to discover new species of bacteria? We have no idea. What we do know is that most of the world's greatest discoveries did not come about through targeted research. They came about when scientists (including quite ordinary people like ourselves) asked questions just for the sake of knowing. We have no idea where the next great idea or discovery will come from.

Objectives and learning outcomes

The main goal of this course, as must be true for any experiential course, is personal development. We want you to build on skills that you've already acquired and learn new ones. Below we summarize our most important

learning objectives and outcomes.

1. Learn to work as a productive member of a research team on a long term project
2. Be able to access and employ published reference materials, current primary literature, and other information sources in order to advance your understanding of the properties of bacteria and how to isolate and characterize them
3. Learn to integrate your previous and newly acquired experience into development of new techniques and strategies
4. Improve your powers of observation, such as the ability to use physical and metabolic differences to distinguish strains and species of bacteria and to draw information from microscopic observations
5. Learn to make the decisions that are necessary in order to conduct a systematic open-ended investigation
6. Learn to make your work accessible to yourself and others by documenting your activities and findings in a well organized laboratory notebook, by contributing to our laboratory's database, and by summarizing your work in a clearly written report
7. Learn and practice good laboratory "citizenship," including respect for people, the facility, and equipment
8. Acquire proficiency in essential methodologies and use your newly acquired skills to advance our project
9. Learn to appreciate the value and potential of pure science, that is, the pursuit of knowledge for its own sake

Please see the Syllabus for course details, course timetable, and a list of assignments with due dates.

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[1]D'Onofrio, Anthony, Jason M. Crawford, Eric J. Stewart, Kathrin Witt, Ekaterina Gavrish, Slava Epstein, Jon Clardy, and Kim Lewis . "Siderophores from Neighboring Organisms Promote the Growth of Uncultured Bacteria." Chemistry & Biology (2010): 254-64.

[2]Offord, Catherine. "Earth: Home to 1 Trillion Microbial Species." The Scientist (2016): http://www.the-scientist.com/?articles.view/articleNo/46016/title/Earth--Home-to-1-Trillion-Microbial-Species/

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BIOC 318 F16 Course Syllabus and Timetable *Click to add start date* *Click to add end date*

Welcome again to BIOC 318. On the home page you will find a brief introduction to the course and a description of the overall course objectives and expected learning outcomes. In addition, please look over the following information about the course, instructors, and policies. Following the course policies is a complete timetable of scheduled activities and assignments with dates, times, and locations when applicable.

The information contained in this syllabus and related pages may be subject to change, with reasonable notice, at the discretion of the instructor.

Instructors and office hours

David Caprette, Teaching Professor
ABL 327 – third floor Anderson Biological laboratory Building
caprette@rice.edu, 713-348-3498 (campus extension 3498)
Office hours are 11 am to 12:30 pm Mondays or by appointment

Charles Stewart, Professor of Biochemistry
GBH W104
crs@rice.edu, 713-348-4926 (campus extension 4926)
Office hours TBD

Preparing for the course

Please plan to apply the skills and best practices that you learned in Bioc 211, Intermediate Experimental Biosciences (course prerequisite) and in Bioc 311, Advanced Experimental Biosciences, if you have had the opportunity to complete that course. Please check the Course Schedule (below), review the meeting schedule for your lab section, and block out the scheduled times on your calendar. You must not schedule events that conflict with any of the listed in-lab activities, nor let anyone schedule a conflicting event for you.

Required materials

You will need eye protection for this course, consisting of a pair of lab goggles or laboratory safety glasses with side protection. A lab coat will be provided. There is no textbook but you will need to obtain a laboratory notebook. You are welcome to start with a partly filled notebook from another course, even one obtained from another student.

New notebooks can be purchased from the campus store or ordered directly from the distributor. Please purchase a Hayden-McNeil Carbonless TOP Permanent Lab Notebook, 50 Set or 100 Set from Amazon, from WH Freeman, or the Campus store (ISBNs below).

Chemistry Top Bound 100 pages, ISBN 978-1-930882-00-3
or
Chemistry Top Bound 50 pages, ISBN 978-1-930882-50-8

Course timetable

All meetings begin at 1 pm except for the introductory meeting on Wednesday Feb 22, which will begin at 2 pm. All meetings will be held in ABL 219 with the exception of the classroom meetings Feb 22-23 (locations to be determined). Documents listed under Preparation can be found in the Resources section on Owl-Space and are also accessible from the side menu on the BIOC 318 web pages.

Sec 001	Sec 002	Preparation	Description of activities
Weds Feb 22, 2:00 pm	Thur Feb 23, 1:00 pm	• Review the course home page and syllabus and have questions ready • Review the documents "Aseptic technique," "Making serial dilutions," and Preparing spread plates," and be prepared for a quiz on the material	• Introductory classroom meeting • Short quiz, lab tour, and practice sessions for dilutions and spreading plates
Mon Feb 27	Tues Feb 28	• Review the documents "Isolating colonies" and "Morphology;" be prepared for a brief quiz • Review the PowerPoint slides in "Course introduction," posted in Resources and on the web	• Prepare agar media and pour plates to be used for isolating colonies • Dilute and spread water samples • Practice sessions on isolating colonies and making streak plates
Weds Mar 1	Thur Mar 2	• Review the documents "Agar slant tubes," "Gram stain," and "Relationship to oxygen," and be prepared for a short quiz	• Prepare agar media for slant tubes and for plates to be used for anaerobic incubations next week • Identify and describe unique colonies on spread plates, streak out onto fresh agar plates
Mon Mar 6	Tues Mar 7		

		• Review previous documents as needed	• Consolidate isolates, conduct anaerobic incubations • Practice making Gram stains • (Tues section only) Gram stain isolates on aerobically incubated plates from the Monday group
Weds Mar 8	Thurs Mar 9	• Again review the document "Relationship to oxygen" • Peruse the document "Using inoculating sticks;" you may prefer this technique over the technique that employs a flame and inoculating loop • Review the document "Using Bergey's manuals"	• Evaluate anaerobically incubated plates for growth • Transfer isolates to agar slant tubes for temporary storage • Sign out a Bergey's manual • (Weds section only) Gram stain isolates on aerobically incubated plates from the Tuesday group • Assemble notebook copy pages, turn in for mid-course evaluation
SPRING BREAK			
Mon Mar 20	Tues Mar 21	• Review the document "Lab responsibilities" and think about which sets of responsibilities you would like to take on • Review the document "Viewing Gram stains;" there may be a short quiz • As you work with the microscope you may want to consult the document "Microscopy procedures," a step by step guide to using our Nikon Labophot microscopes	• Streak out isolates onto fresh plates to rejuvenate cultures • Learn and practice microscopic examination of Gram stains • Evaluate Gram stains • Sign up for one set of lab responsibilities and arrange for training if necessary
Weds Mar 22	Thurs Mar 23	• Enter observations for your isolates into the spreadsheet in Google Sheets	• Learn and practice microscopic observation of living bacteria • Record observations

		• Review the document "Viewing living bacteria;" there may be a short quiz	from microscopic examination of wet mounts of your isolates
Mon Mar 27 thru Weds Apr 19	Tues Mar 28 thru Thurs Apr 20	• Assign isolates to Bergey's Groups, using recorded observations and in consultation with team members • Guided by Bergey's tables, plan strategies for identifying isolates • Peruse the following resources as needed: "Assays," "Assays illustrated," "Characterization writeup," and "Project proposal guidelines"	• Conduct oxidase and catalase tests on all isolates • Conduct additional observations and assays as needed to identify a selected isolate to the species level • Write up your complete characterization of one isolate – upload into Drop Box on or before Friday April 14 • Prepare a proposal for a strategy to isolate rare and/or "uncultivable" bacteria from our water source; up to 3 students may author this assignment, due on or before Friday April 21 in participant's Drop Box

Course grade

Your grade will be based upon your preparation and lab performance (20%), self reliance and contribution to team efforts (10%), laboratory notebook (20%), a monograph on a single bacterial species that you isolate and characterize (25%), and a team-written strategy for isolating rare & difficult to cultivate bacteria (25%).

Additional information and policies

Absences. Because the work in this course is part of a long term goal-oriented project, the concept of a "make-up lab" does not apply. Missing an important event is a lost opportunity that cannot be made up. As far as your course grade is concerned, absences from required meetings will be excused for the usual reasons, e.g., illness or family emergency. Absences due to circumstances within a student's control (e.g., forgetting to show up or travel for interviews) cannot be excused and will be reflected in the performance grade.

Lab safety. All participants must engage in safe laboratory practices and abide by specific "rules" set down for this course.

Late assignments. An assignment that is submitted late will lose 10% per day including holidays and weekends.

Honor code policy. As with all biosciences courses, the Rice University Honor Code applies to all personal conduct and assignments. All work submitted under your name must be your own work, not copied from another source nor completed with unauthorized assistance. Compliance with the honor code includes providing accurate information when requested, such as honest evaluations of yourself and your teammates.

Students with disabilities. Any student with a disability needing academic adjustments or accommodations should contact Dr. Caprette or Dr. Stewart as soon as possible and also contact Disabled Student Services in the Ley Student Center.

Add attachments